PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appeal No. _____

Application No.:	09/803,876
Filing Date:	March 12, 2001
Applicant:	C. Theodore Peachee et al.
Group Art Unit:	2834
Examiner:	Julio C. Gonzalez
Title:	SEGMENTED STATOR SWITCHED RELUCTANCE MACHINE
Attorney Docket:	3174-000002

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BRIEF ON BEHALF OF APPELLANT

This is an appeal from the action of the Examiner dated December 16, 2003, finally rejecting Claims 1 – 21. An amendment has been filed along with the filing of the Appellant's Brief. Copies of the claims appealed corresponding to the co-filed Amendment are attached as an appendix.

I. REAL PARTY IN INTEREST

The real party in interest in the present application is Emerson Electric Co. (Assignee).

II. RELATED APPEALS AND INTERFERENCES

There are presently two related appeals which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal. These appeals include U.S. App. Serial No. 09/824,980, filed April 3, 2001 (Notice of Appeal filed March 31, 2004) and U.S. App. Serial No. 09/817,559, filed March 26, 2001 (Notice of Appeal filed April 8, 2004).

III. STATUS OF THE CLAIMS

Claims 1 – 21 stand finally rejected.

IV. STATUS OF AMENDMENTS

An amendment has been filed along with this Brief. Copies of the claims appealed corresponding to the co-filed Amendment are attached as an appendix.

V. SUMMARY OF THE INVENTION

The present invention provides a switched reluctance machine that includes a stator having a plurality of circumferentially-spaced stator segment assemblies with a stator segment core and winding wire wound around the stator segment core that has slot fill that of greater than 65%. A rotor defines a plurality of rotor poles. The rotor tends to rotate relative to the stator to maximize the inductance of an energized winding. A drive circuit energizes the winding wire around the stator segment assemblies to control operation of the switched reluctance machine based on a rotational position of the rotor.

In other features, each of the stator segment assemblies defines a salient stator pole that extends in a radially inward direction. The inter-polar stator slots are defined between adjacent stator segment assemblies.

In other features, the stator core includes a plurality of stacked stator plates. Each of the stator plates has a generally "T"-shaped cross-section, a radially outer rim section, and a tooth section that extends radially inwardly from a center portion of the radially outer rim section.

VI. ISSUES

A. Whether the combination of Tang '905 in view of Takeuchi et al. '387 and Oki (JP 411 289 701) establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 1 – 5, 8 – 13, 16 – 18 and 21.

B. Whether the combination of Tang '905, Takeuchi et al. '387 and Oki (JP 411 289 701) as applied to claims 1, 9 and 16 and further in view of Akita et al., establish a prima facie case of obviousness under 35 U.S.C. § 103(a), with respect to claims 6, 7, 14, 15, 19 and 20.

VII. GROUPING OF CLAIMS

Claims 1 – 5 and 8 stand or fall together as set forth in section A of the following arguments.

Claims 9 – 13 stand or fall together as set forth in section A of the following arguments.

Claims 16 – 18 and 21 stand or fall together as set forth in section A of the following arguments.

Claim 6 stands or falls by itself as discussed in section B of the following arguments.

Claim 7 stands or falls by itself as discussed in section B of the following arguments.

Claim 14 stands or falls by itself as discussed in section B of the following arguments.

Claim 15 stands or falls by itself as discussed in section B of the following arguments.

Claim 19 stands or falls by itself as discussed in section B of the following arguments.

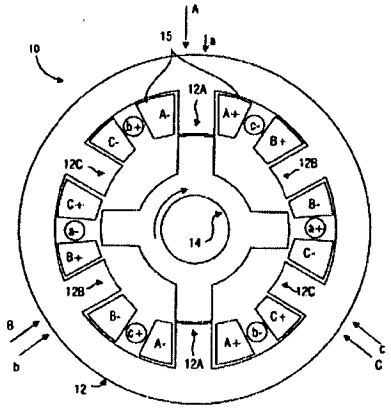
Claim 20 stands or falls by itself as discussed in section B of the following arguments.

VIII. ARGUMENTS

A. The combination of Tang '905 in view of Takeuchi et al. '387 and Oki (JP 411 289 701) does not render obvious the invention of claims 1 – 5, 8 – 13, 16 – 18 and 21.

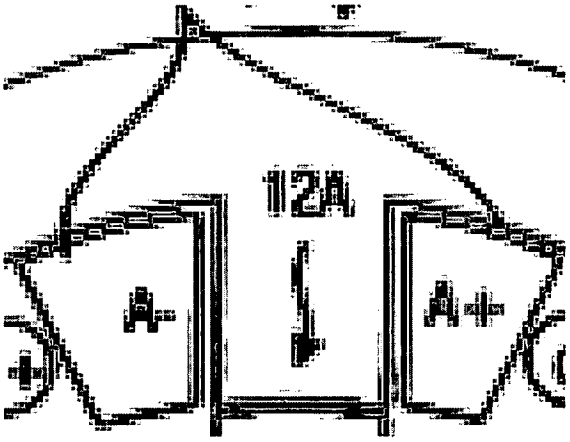
At the outset, Applicants note that claims 1, 9 and 16 each include a segmented stator of a switched reluctance electric machine including a plurality of stator segment assemblies that each have a stator core, wherein the stator core is wound to provide a slot fill of greater than 65%.

Applicants note that Tang does not show, teach or suggest a switched reluctance machine with a segmented stator, as admitted by the Examiner. Tang also does not show, teach or suggest a stator having a slot fill that is greater than 65%. The Examiner has asserted that Figure 1 of Tang, recreated below, inherently shows a switched reluctance motor with a slot fill above 65%.



Applicants respectfully assert that Figure 1 does not inherently show slot fill that is greater than 65%. More specifically, the drawing is in schematic form and does not appear to show relative sizes. For example, the windings are not uniformly wound around the stator teeth. In particular, A- and A+ have different sizes and are not symmetric, which would be

impossible since the same winding wire that is used to wind A+ would also form A-. An enlarged view of A+ and A- is set forth below:



Further, the specification of Tang is silent as to slot fill. Figure 1 of Tang also shows large gaps (labeled a+, a-, b+, b-, c+, and c-), which do not include winding wire and would reduce the slot fill percentage. Since the stator is not segmented, Applicants presume that either needle winding or transfer winding methods would be used to wind the stator. Neither of these approaches achieve slot fills that are greater than 65%. **Applicants Specification ¶ [0015].** At best, Tang could achieve 60-65% slot fill with the transfer winding approach discussed by Applicants. **Id.**

Furthermore, claims 1, 9 and 16 do not claim high slot fill alone, but claim high slot fill in combination with a segmented stator switched reluctance machine. By enabling the stator segments to be wound before assembly, which can only be achieved using segmented stators, the electrical uniformity of the inductance and resistance values of the stator poles is improved. This combination enables the drive circuit to determine the rotational position of the rotor without sensors.

Takeuchi et al. does not show, teach or suggest a switched reluctance machine. Takeuchi et al. relates to permanent magnet machines, not switched reluctance machines.

Oki does not show, teach or suggest a stator having a slot fill that is greater than 65%. Oki also does not expressly address switched reluctance machines. The Examiner incorrectly characterizes Oki by stating that "Oki teaches ... for the purpose of making a motor with superior electromagnetic performance that a reluctance motor may be made by having a segmented stator." **Final Office Action at p. 3.** In support of this statement, the Examiner relies upon Figure 4 of Oki, which admittedly shows a segmented stator. However, the text of Oki specifically states that the stator was segmented to make the assembly/manufacturing of the machine easier. Oki states:

> Accordingly, due to the fact that the stator is divided for each electrode unit, it is possible to readily carry out the coil-winding operation for each layered core, so as to enhance the efficiency of producing reluctance motors.

Oki translation at pp. 3-4. Therefore, Oki segments the stator to make manufacturing easier – not to improve the electromagnetic characteristics of the switched reluctance machine or to make the sensorless approach easier to implement. Further, Oki fails to teach or suggest increasing the slot fill beyond the percentage that could be obtained using a non-segmented stator. The only portion of Oki that relates to improving electromagnetic performance is the removal of caulking and welding of the stator laminations.

According to Oki, the stator of the reluctance machine is segmented to improve manufacturing efficiency. **Id.** Oki also does not increase the slot fill above levels that can be obtained through conventional methods. In particular, the slot fill of the segmented stator in Oki is approximately 62%, which is approximately in the range of conventional transfer winding (approximately 60-65% slot fill). **Declaration of Dr.**

Wallace at Paragraphs 3-4, submitted with Amendment 2/24/03. Therefore, Oki did not segment the stator to improve the torque density either.

It should be further noted that the combination of features provided in each of claims 1, 9 and 16 provide particular advantages that are unique to switched reluctance machines. Sensorless control of brushless permanent magnet machines and induction machines currently do not operate properly if the iron core is heavily saturated with magnetic flux. **Dr. Wallace Declaration** (attached to prior Amendment) at paragraph 5. Switched reluctance machines, on the other hand, are frequently operated with levels of magnetic flux in their iron cores that exceed the levels used in other types of electric machines. **Id.** at paragraph 6. Sensorless control systems for switched reluctance machines do operate properly if the iron core is heavily saturated with magnetic flux. **Id.**

By segmenting the stator and increasing slot fill of the switched reluctance machine, the diameter of the winding wire can be increased using the same number of turns. **Id.** at paragraph 7. The increased diameter of the winding wire allows increased current to be driven through the windings, which increases torque output. **Id.** at paragraph 8. The increased current levels also increase magnetic loading and magnetic saturation. **Id.** at paragraph 9. Therefore, the benefits of a segmented stator in combination with a high slot fill are unique to switched reluctance machines with sensorless drive circuits as claimed in independent claims 1, 9 and 16.

With regard to the rejections of claims 1, 9 and 16 in general, the Examiner incorrectly relies on **In re Fine**, 5 U.S.P.Q.2d, 1596 (CAFC 1988) and **In re Jones**, 21 USPQ.2d 1941 (Fed. Cir. 1992). The facts and the holdings of these cases do not support the Examiner's conclusion under §103. More specifically, in both **In re Fine** and **In re**

Jones, the CAFC reversed the Board and the Examiner based upon the Examiner's unsupported reliance upon the general knowledge of one skilled in the art. As in the instant case, the Examiners in both **In re Fine** and **In re Jones** combined features of two references in the same broad category of art and relied upon the general knowledge of one skilled in the art in making the combination. As in the instant case, the Examiners in **In re Fine** and **In re Jones** did not support the combinations by identifying specific teachings, suggestions or motivations found in the references.

Both **In re Fine** and **In re Jones** reject the proposition that the teaching, suggestion or motivation required by §103 is present simply because the references all relate to the same broad category of art or that unsupported general knowledge of one skilled in the art can be relied upon. The Examiner is essentially asserting that it would be obvious for skilled artisans to try the features of one device in another similar device. The CAFC expressly rejected the "obvious to try theory" in **In re Fine** at 1598.

The unsupported reliance on the general knowledge of one skilled in the art that was made by the Examiner here is exactly the type of conclusion that supported the reversal of the Board and the Examiner by the CAFC in both **In re Fine** and **In re Jones**. In supporting the combination, the Examiner states that the references "are well in the field of electric machines." **Final Office Action** at paragraph 5. The Examiner goes on to state:

> In response to applicant's arguments that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining and modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See In re Fine, 837 F.2d

> 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988) and In re Jones, 958 F.2d 347, 21 USPQ.2d 1941 (Fed. Cir. 1992). **In this case, the references deal with electric machines, especially motors and improvements of such machines.**

Final Office Action at paragraph 5 (Emphasis added). In summary, the only teaching, suggestion, or motivation that is relied upon by the Examiner is simply that the references all relate to electric machines.

The Examiner's reasoning is exactly the type of speculation that formed the basis for reversal of the Examiner and the Board in **In re Jones**:

> Conspicuously missing from this record is any evidence, other than the PTO's speculation (if it be called evidence) that one of ordinary skill in the herbicidal art would have been motivated to make the modifications of the prior art salts necessary to arrive at the claimed 2-(2 '-aminoethoxy) ethanol salt... We conclude that the PTO did not establish a prima facie case of obviousness.

In re Fine also rejected this reasoning. The prior art reference related to a similar device – namely gas chromatographs. **Id.** The prior art chromatograph detected sulfur while Applicants' chromatograph detected nitrogen. **Id.**

In view of the foregoing, the combination of the references is improper and otherwise fail to teach or suggest all of the elements of the claim, as set forth. Therefore, Applicants respectfully request that this Board overturn the Examiner's rejection of claims 1, 9 and 16.

With regard to claims 2 – 5, 8, 10 – 13, 17, 18 and 21, Applicants note that each ultimately depend from one of claims 1, 9 and 16, which define over the prior art, as discussed in detail above. Therefore, claims 2 – 5, 8, 10 – 13, 17, 18 and 21 also define over the prior art. Accordingly, Applicants respectfully request that this Board overturn the Examiner's rejection of claims 2 – 5, 8, 10 – 13, 17, 18 and 21.

B. The combination of Tang '905, Takeuchi et al. '387 and Oki (JP 411 289 701) as applied to claims 1, 9 and 16 and further in view of Akita et al. , does not render obvious the invention of claims 6, 7, 14, 15, 19 and 20.

Applicants incorporate the above discussion regarding claims 1, 9 and 16.

Claims 6, 14 and 19 include first and second end caps connected to opposite face surfaces of the stator segment core and first and second end cap retainer sections that extend along the projections and that connect the first and second end caps. The first and second end caps and the first and second end cap retainer sections reduce movement of the winding wire during use.

None of the prior art references teach or suggest first and second end caps and first and second end cap retainer sections. The Examiner has asserted that Akita et al. teaches end caps, referencing Figure 36. Figure 36, however, illustrates insulating bobbins and not end caps (col. 23, lines 29 – 42). Therefore, Akita et al. fails to disclose end caps and claims 6, 14 and 19 define over the prior art. Accordingly, Applicants respectfully request that this Board overturn the Examiner's rejection of claims 6, 14 and 19.

Claims 7, 15 and 20 each include stator plates of the stator segment core having radial and lateral slits and first and second central portions that are deformed using a punch to hold the stack of stator plates together.

None of the prior art references teach or suggest radial and lateral slits and first and second central portions that are deformed using a punch to hold the stack of stator plates together. Accordingly, Applicants respectfully request that this Board overturn the Examiner's rejection of claims 7, 15 and 20.

IX. CONCLUSION

In view of the above presented discussion, Applicants believe that the pending claims are patentably distinguishable over the art cited by the Examiner. Accordingly, Applicants respectfully request that this Board reverse the final rejection of claims 1 – 21.

A check in the amount of $330 for filing a brief in support of this appeal is enclosed herewith. Please charge any deficiency or credit any overpayment pursuant to 37 C.F.R. § 1.16 or § 1.17 to Deposit Account No. 08-0750.

Respectfully submitted,

Dated: 6/7/04

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Enclosures: Three (3) copies of Appellant's Brief

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APPENDIX

1. A switched reluctance machine comprising:

a stator including a plurality of circumferentially-spaced stator segment assemblies with a stator segment core and winding wire wound around said stator segment core that has slot fill that is greater than 65%;

a rotor defining a plurality of rotor poles, wherein said rotor tends to rotate relative to said stator to maximize the inductance of an energized winding; and

a drive circuit that energizes said winding wire around said stator segment assemblies to control operation of said switched reluctance machine based on a rotational position of said rotor.

2. The switched reluctance machine of claim 1 wherein said stator segment core include a stack of stator plates.

3. The switched reluctance machine of claim 2 wherein said stator plates include:

a radially outer rim section; and

a tooth section that extends radially inwardly from a center portion of said radially outer rim section.

4. The switched reluctance machine of claim 3 further comprising:

an insulation layer located between said winding wire and said stator segment core.

5. The switched reluctance machine of claim 3 further comprising:

projections extending from opposite sides of a radially inner end of said tooth section.

6. The switched reluctance machine of claim 5 further comprising:

first and second end caps connected to opposite face surfaces of said stator segment core; and

first and second end cap retainer sections that extend along said projections and that connect said first and second end caps,

wherein said first and second end caps and said first and second end cap retainer sections reduce movement of said winding wire during use.

7. The switched reluctance machine of claim 2 wherein said stator plates of said stator segment core include radial and lateral slits and first and second central portions that are deformed using a punch to hold said stack of stator plates together.

8. The switched reluctance machine of claim 1 wherein said drive circuit senses rotor position using sensorless techniques.

9. In a switched reluctance machine that includes a stator, a rotor and a machine housing, an improved stator comprising:

a plurality of circumferentially-spaced stator segment assemblies that are arranged around an inner surface of said machine housing of said switched reluctance machine,

each of said stator segment assemblies defining a salient stator pole that extends in a radially inward direction, wherein inter-polar stator slots are defined between adjacent stator segment assemblies, and

said stator segment assemblies including a stator segment core and winding wire that is wound around said stator segment core and that has a slot fill that is greater than 65%.

10. The improved stator of claim 9 wherein said stator segment core includes a stack of stator plates.

11. The improved stator of claim 10 wherein each of said stator plates includes:

a radially outer rim section; and

a tooth section that extends radially inwardly from a center portion of said radially outer rim section.

12. The improved stator of claim 11 further comprising:

an insulation layer located between said winding wire and said stator segment core.

13. The improved stator of claim 9 further comprising:

projections extending from opposite sides of a radially inner end of said tooth section.

14. The improved stator of claim 13 further comprising:

first and second end caps connected to opposite axial ends of said stator segment core; and

first and second end cap retainer sections that extend along said projections and that connect said first and second end caps,

wherein said first and second end caps and said first and second axial end cap retainer sections reduce movement of said winding wire during use.

15. The improved stator of claim 10 wherein said stator plates of said stator segment core include radial and lateral slits and first and second central portions that are deformed to hold said stator segment core together.

16. A switched reluctance machine comprising:

a machine housing;

a rotor that rotates relative to said machine housing of said switched reluctance machine; and

a stator that is mounted on an inner surface of said machine housing, said stator including a plurality of circumferentially-spaced stator segment assemblies, wherein said stator segment assemblies include a stack of stator plates forming a stator segment core and winding wire that is wound around said stator segment core and that has a slot fill that is greater than 65%,

wherein each of said stator plates has a generally "T"-shaped cross-section, a radially outer rim section, and a tooth section that extends radially inwardly from a center portion of said radially outer rim section.

17. The switched reluctance machine of claim 16 further comprising:

an insulation layer located between said winding wire and said stator segment cores.

18. The switched reluctance machine of claim 16 further comprising:

projections extending from opposite sides of a radially inner end of said tooth section.

19. The switched reluctance machine of claim 18 further comprising:

first and second end caps connected to opposite axial ends of said stator segment core; and

first and second end cap retainer sections that extend along said projections and that connect said first and second end caps,

wherein said first and second end caps and said first and second end cap retainer sections reduce movement of said winding wire during use.

20. The switched reluctance machine of claim 16 wherein said stator plates of said stator segment core include radial and lateral slits and first and second central portions that are deformed to hold said stator segment core together.

21. The switched reluctance machine of claim 16 further comprising:

a drive circuit connected to said winding wire of said stator segment assemblies, wherein said drive circuit senses rotor position using sensorless rotor techniques.